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Knowledge management and its link to artificial intelligence

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Abstract

Knowledge management is an emerging area which is gaining interest by both industry and government. As we move toward building knowledge organizations, knowledge management will play a fundamental role towards the success of transforming individual knowledge into organizational knowledge. One of the key building blocks for developing and advancing this field of knowledge management is artificial intelligence, which many knowledge management practitioners and theorists are overlooking. This paper will discuss the emergence and future of knowledge management, and its link to artificial intelligence. © 2001 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Business process reengineering (BPR), Year 2000 (Y2K), and now knowledge management (KM). Is knowledge management something as a fad that the consultants dreamed up to keep themselves gainfully employed in the coming years or should knowledge management be treated as a strategic goal in organizations for better capturing, sharing, and leveraging knowledge internally and externally? Some concern and possible pessimism (or perhaps conservatism) exist in embracing knowledge management and undertaking knowledge management initiatives. One concern is that a fair percentage of senior managers believe that knowledge management may just be embellished information management and business process reengineering (BPR) efforts. Many BPR efforts have been failures, so there is concern that knowledge management may fall victim to the same perils. A second issue is that there seems to be very little rigor being put into developing the knowledge management methodologies. Only a few companies, like RWD Technologies, Andersen Consulting, Dataware Technologies, The Delphi Group, and selected others, have developed rigorous, comprehensive methodologies for building knowledge management projects. Coupled with this issue is that the knowledge management field is becoming amorphous as vendors are claiming that their products are "knowledge management" tools, whereas they simply may be document management or information management products.

2. Knowledge management and its underlying concepts

Knowledge management (Liebowitz, 1999; Liebowitz, 2000; Liebowitz and Beckman, 1998) is the process of creating value from an organization's intangible assets. It deals with how best to leverage knowledge internally in the organization and externally to the customers and stakeholders. As such, knowledge management combines various concepts from numerous disciplines, including organizational behavior, human resources management, artificial intelligence, information technology, and the like. The focus is how best to share knowledge to create value-added benefits to the organization.

Many people confuse information with knowledge. There is a significant difference. According to Hubert St. Onge of The Mutual Group, information is patterned data and knowledge is the capability to act. Knowledge includes the set of facts and rules of thumb that experts may have acquired over many years of experience. In a master–apprenticeship relationship, knowledge is hopefully what the master shares with the apprentice versus simply information.

Knowledge then takes various forms. Tacit knowledge is the knowledge of the subconscious which is something done automatically without almost thinking. This type of knowledge is difficult to extract and elicit due to the knowledge engineering paradox. The more expert one is, the more compiled the knowledge, and the harder it is to extract this knowledge and formalize it in a knowledge repository. Explicit knowledge is another type of knowledge that is more obvious and can be more easily documented. Internalized knowledge is how the explicit knowledge is internalized, shaped, or influenced by one's own views and

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therefore may take a different form from one person to another.

Typically, many organizations will need to use a dual strategy to uncovering and sharing these types of knowledge. A codification approach will be needed to formalize and document the knowledge in a knowledge repository. A personalization approach is also used to encourage informal communications to hopefully uncover tacit knowledge and transfer it from one individual to another. Organizations like Johnson & Johnson and The World Bank have knowledge fairs or knowledge exchanges to encourage this informal communication process.

What is the merit of the ideas underlying knowledge management? If Sir Francis Bacon's adage of "knowledge is power" is well regarded, then a new motto of extending this concept may be "sharing knowledge is power". Top management has recognized that their competitive advantage typically is their people — the brainpower or intellectual capital in the organization. If there is a way to harness, capture, secure, and then share this knowledge among the employees and customers, then tremendous synergies could result (as well as building the institutional memory of the firm). Already, companies are claiming significant benefits derived from their knowledge management efforts. Pfizer, Skandia, Buckman Labs, Texas Instruments, the World Bank, and other organizations are already seeing tangible benefits from their knowledge management initiatives. As one CEO said, "if we only knew what we know", this type of thinking could give an organization a competitive edge.

Learning from others has always been a preferred practice, assuming that the "others" give knowledgeable, sage advice. Many organizations have developed lessons learned databases and best/worst practice repositories to formalize, document, and share these lessons learned. Of course, there needs to be an infrastructure within the organization that is actively capturing and validating these lessons learned and then analyzing and disseminating them to appropriate individuals in the organization. Additionally, a knowledge sharing culture needs to be created to include an incentives/reward system to motivate others to share their knowledge. Building this supportive culture is critical in the possible success of a knowledge management initiative.

To date, there have been some interesting lessons learned with respect to the development and implementation of knowledge management initiatives in organizations. First, most organizations are piloting small knowledge management efforts within a targeted business area in a department versus incorporating knowledge management into the overall organization's strategy for enterprise-wide development and deployment. This is a risk-averse approach to show if these knowledge management pilot efforts are successful, then they can be scaled up for widespread organizational adoption and deployment. In the long run, however, for knowledge management to be truly successful, it needs to be integrated within the overall strategic vision of the organization. Many of the pilot efforts take the form of a knowledge audit, best practices/lessons learned knowledge repository, or an on-line yellow page directory of expertise/experts in the organization.

Another interesting observation is just because you are using tools like Lotus Notes, does not mean you are necessarily doing knowledge management. These types of tools will facilitate building a knowledge management technological infrastructure, but knowledge management is much more than tools and technology. In fact, it is more people and culture and this needs to be carefully considered in order to develop a knowledge sharing environment.

A last major lesson learned is that most organizations do not have a rigorous, comprehensive knowledge management methodology for creating these knowledge management systems and initiatives. Part of the reason for this phenomenon is that the knowledge management providers themselves do not have comprehensive knowledge management methodologies. A few companies have fairly comprehensive methodologies for knowledge management, but most do not. This leads to the confusion and skepticism in the marketplace created by overhype and mislabeling of tools and techniques by so-called knowledge management vendors. This has happened in the past to the artificial intelligence (AI) community which has flowed through peaks and valleys in terms of AI winters and springs until the expectations were brought into alignment.

Is knowledge management an outgrowth of information management and document management? Partly yes. But it also covers other areas including artificial intelligence, knowledge-based systems, information technology, human resource management, groupware, organizational behavior, and related disciplines. Bob Buckman, CEO of Buckman Labs, says that building a supportive culture for knowledge management is 90% of the effort. This is often overlooked, as many knowledge management efforts are being born in the information technology or information systems departments of organizations. Their concentration has been on the underlying technology for building their knowledge management systems, versus strongly considering the people and cultural aspects of knowledge management. In a way, it is a chicken and the egg situation. If you do not have the necessary technological infrastructure to support knowledge management systems, then the knowledge management effort may be wasted time. But, if people are not willing to share their knowledge, no matter how easy it is to input it into a knowledge management system, then the knowledge management effort will also fail. Thus, careful attention and consideration of both the people/cultural and technology areas must be adequately addressed.

For those knowledge management efforts that have failed, there are generally three major reasons. The first is that the knowledge management strategy was not tied to the business/mission of the organization. Second, there may have been a lack of strong and active top management support and involvement. Third, the knowledge management plan/program may have been poorly designed. Interestingly,

these reasons are also typical of most information system project failures.

Are senior managers receptive to the idea of knowledge management? To help test the waters, a knowledge management receptivity study was conducted by Liebowitz in the Summer 1999 at the corporate headquarters of a major pharmaceutical company. The response rate was about 75%, and the survey was sent to senior managers within the headquarters of this company.

In analyzing the survey results, the first five questions dealt with the human capital perspective. The survey responses indicate that the pharmaceutical organization under study has a firm and clear understanding of the value of its employees, especially the "experts" in the organization. Ninety-eight percent indicated agreement that managers' awareness of the importance of providing their expert employees with challenging work is a necessary ingredient to retain knowledge in an organization. Ninety-six percent indicated that organizations need to have very clear strategies for retaining their expert employees. Ninety-three percent indicated that expert employees are the most valuable resource for organizations. There was some ambiguity over the terms "knowledge worker" and "knowledge work", as 59% agreed (36% neutral) that higher level professional work, which contributes to the satisfaction of customer needs, would correctly be termed "knowledge work". Seventy-eight percent (20% neutral) felt that knowledge workers are the primary contributors to success in organizations.

With respect to the questions dealing with the "knowledge perspective", it appeared that most people were not familiar with the term or concept of a "knowledge organization". About 36% were familiar with the term, 25% neutral, and 39% were unfamiliar. It was also evident that the respondents did not feel that the organization was ready to transform itself into a learning organization. Only 22% agreed that the organization was ready to be transformed into a learning organization (49% were neutral, 29% disagreed). The vast majority of the respondents agreed that to be truly successful in business today (79% agreed) and in the future (81% agreed), one needs to see the world from a knowledge perspective.

With respect to the questions dealing with the Chief Knowledge Officer perspective, most people were neutral (56%) or had mixed feelings (28% agreed, 16% disagreed) that there should be a separate "Knowledge Manager" position as a part of the company's structure. Some annotated comments indicated that there should be knowledge managers spread out through the different business units in the company. The respondents, however, felt favorably (63%) that the organization should commit additional human/financial resources to managing knowledge (31% were neutral).

The two most interesting results were that there were mixed results on whether the senior management has the leadership capability to succeed in knowledge management. Fifty-six percent agreed, 36% were neutral, and 8% disagreed. Even though the survey indicated that some of the knowledge management terms may be foreign to many of the respondents, they believe strongly in the value of knowledge and human capital. This was evidenced by 82% of the respondents indicating that the "intangible" (i.e. knowledge/intellectual capital assets) in organizations should be measured.

So what are the tell-tale signs that knowledge management may be needed in your organization? Here are a few to consider:

- the average age of your employees is fairly senior;
- you have not done a good job of documenting processes and capturing knowledge;
- your competitors seem to have an edge on you and may also be engaged in knowledge management efforts;
- there does not seem to be a mentoring program to help share and transfer knowledge between the experts and novices (i.e. newcomers) in the organization;
- little funding has been put into employee training and development;
- one part of the organization doesn't know what the other part is doing — even if working in a similar domain;
- you spend a good part of the day looking for information that has been misplaced;
- you do not feel you have the time to chat with your colleagues in the organization in an informal way;
- many of your knowledgeable employees are leaving the firm either through early buy-outs, better job offers, or other reasons.

These signs may not be even early warning ones — some may indicate that you are too late! Should you start panicking now? Not really, here are a few suggestions to consider:

- Provide a weekly or monthly Knowledge Management Forum Series for your organization to better educate everyone in knowledge management and create further awareness.
- Select a targeted business area and conduct a knowledge audit to see the types of knowledge needed for that area, the knowledge that is available and missing, who has the knowledge, and how is that knowledge being used.
- Attend some knowledge management seminars or conferences — many of which are industry-focused.
- Bring in some knowledge management "advisors" who could help shape a knowledge management strategy for the organization.
- Start developing some best practices/lessons learned/yellow pages of expertise for your organization.

These suggestions will quickly get you started. Once awareness of knowledge management principles and ideas is created, then the organization can better assess how to develop a knowledge management infrastructure and

sharing culture within the organization. This may involve selecting a Chief Knowledge Officer (CKO) or equivalent to help spearhead the knowledge management initiative within the organization. Typically, the CKO is appointed by the CEO and reports directly to the CEO for maximum effectiveness. Other organizations have numerous knowledge managers in the business units to act as the knowledge advocates, sponsors, or integrators. The HR (Human Resources Department) in the organization will also need to play a strong role in the knowledge management culture building process.

What would be the ideal type of knowledge management system for an organization? The answer to this question depends on the type, business, and culture of the organization and how broadly knowledge management is to permeate the organization. Ideally, the knowledge management system might contain some of the following capabilities: be accessible 24 hours a day, seven days a week to all employees and management (as well as to customers); be able to handle different languages; have easy ways of inputing information and knowledge into the knowledge repository with validity checks performed for correctness and reliability of the input; have intelligent agents perhaps that will automatically analyze incoming lessons learned and disseminate them immediately to appropriate individuals who could benefit from those lessons; have easy ways of maintaining these knowledge repositories and apply knowledge discovery techniques to induce new knowledge from these repositories; be able to access the knowledge management system in an easy and portable manner no matter where you are in the world (perhaps via your personal digitized assistant).

In the Progressive Policy Institute's Technology Project Report (July, 1999) on the State of the New Economy, it indicates the following:

"In the New Economy, states will prosper if their workers are good with their minds, because knowledge and information-based jobs are driving the New Economy. Many of these jobs are in offices. They tend to be managerial, professional, and technical positions held by individuals with at least two years of college. Moreover, skill requirements are going up in most industries and occupations, not just the high-tech sector. The "knowledge jobs" indicators (used in the study) measure three things: (1) the percentage of the workforce working in offices; (2) the share of the workforce employed in managerial, professional, and technical positions; and (3) the education level of the workforce."

As we brace ourselves for the Knowledge Age, knowledge management should be a key tenet in an organization's philosophy. The emergence of knowledge management is real, and if done properly, could have tremendous value-added benefits to the organization. Intangible assets, not simply tangible ones, will form, as Tom Stewart of Fortune and Karl-Erik Sveiby of Australia indicate, the new wealth of the organization.

In order for knowledge management to survive as a critical and strategic concept in organizations, the knowledge management field needs to borrow from other established disciplines, like artificial intelligence (AI), in order to learn and apply what others have already accomplished towards advancing the knowledge management field. The next section will look at this linkage.

3. Applying AI techniques to advance knowledge management

In looking at ways for sharing knowledge, transforming individual knowledge into collective, organizational knowledge, and reincarnating organizations into "knowledge organizations", the field of artificial intelligence (AI) can help push these basic tenets of knowledge management. One of the important areas of knowledge management is knowledge capture and representation. The knowledge engineering (Hendriks and Vriens, 1999) methodologies for building expert systems have applied knowledge acquisition techniques (e.g. interviewing, protocol analysis, simulation, personal construct theory, card sorting, etc.) for eliciting the tacit knowledge from domain experts. In order to develop knowledge repositories in knowledge management systems for formally documenting knowledge in an on-line way, these knowledge acquisition techniques could be applied. Additionally, knowledge discovery and data/text mining approaches (AI-related methods) could be used to inductively determine relationships and trends in these knowledge repositories for creating new knowledge. In order to represent this knowledge in these repositories, a knowledge taxonomy and knowledge mapping are typically constructed for serving as the frameworks on which to build these knowledge repositories. Knowledge ontologies and ways for representing acquired knowledge (rules, cases, scripts, frames/objects, semantic networks, etc.) are typically created in the AI field for building expert and other intelligent systems. The knowledge management field can apply these AI techniques to help codify the knowledge in the knowledge management systems. Other AI techniques like intelligent agents (Bradshaw et al., 1998) can be used to help in the search and retrieval methods of knowledge in the knowledge management systems. Agents can be used to help in combining knowledge which would ultimately lead to the creation of new knowledge. The AI Applications Institute at the University of Edinburgh has developed an adaptive workflow system, using agent technology, to support knowledge management. Natural language and speech understanding front-ends as interfaces to knowledge management systems may be worthwhile AI techniques to apply in the coming years to the knowledge management field.

Knowledge distribution, one of the basic functions of knowledge management, involves sending knowledge internally and externally to those who could benefit from the use and application of the knowledge. Typically, there is an infrastructure within the organization whose

responsibility is to disseminate the knowledge to pertinent individuals or groups. Instead of simply having a passive distribution mode where it is up to the individual workers to access the organization's knowledge repository, it may be preferable to have a knowledge management team in charge of analyzing the knowledge and distributing it to employees, management, customers, and stakeholders, as relevant. There are also techniques that could be used to assist in this process. Intelligent agents could be applied to analyze the knowledge, email, web pages, and the like and to disseminate appropriate summaries or individual pieces of information and knowledge to those who should best make use of it. Data mining and knowledge discovery techniques could also be employed to inductively look for trends, relationships, and possibly new knowledge and information from the organization's knowledge repositories. This is already being done effectively in the marketing and finance fields.

Online communities, which share a common interest with knowledge management, are also ways of sharing and distributing knowledge. These may mimic Centers of Expertise or Knowledge Centers or Communities of Practice in organizations. Members of these communities share their experiences, thoughts, information, questions/answers, and knowledge over the web. For example, online communities exist for Parkinsons Disease, Downs Syndrome, and other health related online communities. Knowledge is distributed via the web to members of these online communities.

4. The future of knowledge management

A key question is "will knowledge management be a lasting concept five to ten years down the road?" The answer to this question depends partly on the effect of unnecessary hype and overexpectations built from the so-called knowledge management vendors and partly on management's realization that knowledge management is a critical thread that needs to be interwoven within their organization and culture. Let us respond now to each of these component parts.

With respect to the hype and possible overexpectations that may be created by the knowledge management vendors, this is a real concern. Many of the information management, document management, and artificial intelligence vendors are claiming that their tools are now "knowledge management" tools. Part of the confusion stems from not having a universal sets of terms, vocabulary, concepts, and standards in the knowledge management community. This needs to be addressed, and in fact, an organization called the "International Knowledge Management Consortium (http://km.org)" is trying to develop such standards. Additionally, many of the knowledge management providers are jumping on the knowledge management bandwagon without having rigorous, well-documented methodologies and techniques for performing knowledge management. Until these methodologies are developed and applied successfully, there may be a lack of understanding resulting from ill-defined concepts and approaches.

In terms of management's recognition of the importance of knowledge management to their organization, the marketplace will probably dictate the truth and strength of this proposition. If one's competitors are using knowledge management effectively in their organizations to get value-added benefits and a greater market share, then this will drive other organizations to try to keep up with their competitors. Additionally, many organizations have a graying workforce and this may dictate the need for capturing and sharing the expertise of those experts before they retire and leave the organization. This may be a primary reason for embracing knowledge management concepts.

Senior management, though, wants to get a bottom-line from their investments, and knowledge management initiatives will need to show tangible results from the organization's intangible knowledge assets. This suggests the need for continuing to develop measures and metrics to quantify intangible assets instead of merely using anecdotal evidence. Various researchers, educators, and practitioners are looking at methods to measure knowledge management benefits, but this is still an open issue. Once generally accepted techniques for doing this are approved in the community, senior management will be less reluctant to engage in these knowledge management initiatives.

Assuming that the expectations of knowledge management can be brought into alignment and senior management understands the value for knowledge management efforts in their organizations, then the future looks bright for knowledge management. However, there are some potential pitfalls that could squash knowledge management initiatives in the organization. Here are a few of them:

- The organization culture is strictly a "knowledge is power" climate versus a "sharing knowledge is power" environment, and techniques used to cultivate a knowledge sharing culture are not successful in remedying this situation.
- The true value of knowledge management is not realized because the organization does not embed knowledge management within the strategic vision of the firm.
- The knowledge repositories become unwieldy and difficult to maintain.
- Security of the knowledge repositories may be compromised if the "gems of the organization" are put on-line.
- The knowledge management system is ill-designed and difficult for the user to utilize.
- The knowledge management program plan is ill-conceived and problematic.
- If the employees are not "incentivized" in some way, knowledge sharing will likely be underachieved.

Organizations need to be careful of these potential pitfalls when undertaking knowledge management efforts. A key element of making knowledge management successful in the

organization is using proper "change management". Building a supportive culture for knowledge sharing should be a function of change management in the organization. Providing a smooth transition to a knowledge management environment is part of the challenge of change management. People naturally resist change, so the change management steps and processes should help cultivate a buy-in effect by those in the organizations for knowledge management roles and values.

If change management is done well and if the potential knowledge management pitfalls are avoided, then knowledge management has a bright future for building organizational intelligence and growth. Organizational learning and knowledge management go hand-in-hand, and if the roots of the organization are nourished (i.e. employee training and development) then the organizational tree should blossom. This should augment organizational learning and provide a mechanism for transforming individual learning into organizational learning.

However, if the knowledge management marketplace creates hype, overexpectations, and vaporware, then this could ultimately kill the "goodness" of a knowledge management strategy. Hopefully, the vendors will not continue to mislabel many of their tools as being "knowledge management" ones. Standard terminology and usage in the knowledge management field needs to be developed. As the dust settles at the end of the day, hopefully knowledge management will be one of the shining lights, in the future, reflecting its rays through the organizational dust.

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